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## **Gulf Sturgeon Movements In and Near the Mississippi River Gulf Outlet**

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**Abstract:** The Mississippi River Gulf Outlet (MRGO) provides year-round navigation between the Mississippi River and the Gulf of Mexico. Dredging, which is periodically required to maintain navigation, may impact Gulf sturgeon. Consequently, Gulf sturgeon use of the MRGO and nearby disposal areas was monitored monthly from 2004 through 2006 using telemetry tracking. A total of 50, 40, and 20 Gulf sturgeon were captured yearly by netting in the Pearl and Bogue Chitto Rivers and fitted with transmitters. One tagged Gulf sturgeon was located in the MRGO on 19 January 2005 near marker 96 (29°50.669N 089°37.643W). Starting in June 2006, intensive gill netting of disposal sites was initiated as telemetry monitoring continued. No other Gulf sturgeon were located by telemetry nor were any caught in experimental gill nets near inland disposal sites despite more than 10,600 net meter hours of effort expended in 2006. This study thus suggests that Gulf sturgeon infrequently use the MRGO and nearby disposal areas.

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## Preface

The U.S. Army Engineer District, New Orleans, provided funding for this study, which was managed by Elizabeth H. Behrens.

This report was prepared by Dr. James P. Kirk of the Aquatic Ecology and Invasive Species Branch (AEISB), Ecosystem Evaluation and Engineering Division (EEED), Environmental Laboratory (EL), U.S. Army Engineer Research and Development Center (ERDC).

Bradley Lewis, Jay Collins, William Lancaster, and Steven George of AEISB participated in field collections, as did R. Timothy Ruth, Brian McCormack, and Jeff Thompson of the Louisiana Department of Wildlife and Fisheries.

Technical reviews were provided by Dr. K. Jack Killgore and Dr. Jan J. Hoover, EL. ERDC supervision was provided by Dr. Timothy E. Lewis, Chief, AEISB; Dr. David J. Tazik, Chief, EEED; and Dr. Elizabeth C. Fleming, Director, EL.

COL Richard B. Jenkins was Commander and Executive Director of ERDC. Dr. James R. Houston was Director.

# 1 Introduction

The Gulf of Mexico sturgeon (*Acipenser oxyrinchus desotoi*) or Gulf sturgeon was federally listed during 1991 (USOFR 1991). A subspecies of the Atlantic sturgeon (Vladykov 1955), this fish ranges along the Gulf coast from Florida to the Mississippi River (Grunchy and Parker 1980). Winters are spent in estuarine and marine habitats and much of the rest of the year is spent in coastal rivers (Odenkirk 1991; Foster 1993; Clugston et al. 1995; Rogillio et al. 2007).

Gulf sturgeons usually show fidelity to a single river system and movements between rivers are uncommon. Populations are therefore described on a river system basis. Some major coastal rivers remained unstudied, but Gulf sturgeon populations and recovery potential in the Pearl River system in Mississippi – Louisiana has been addressed previously (Morrow et al. 1998a, 1998b, 1999). Rogillio et al. (2007) were the first to describe the chronology of movements out of the Pearl River and to track the movements of tagged Gulf sturgeon into brackish water and marine habitats. This study described movement into brackish waters as early as September and movement into marine habitats by November. Tagged fish remained in marine waters through early March and brackish waters through June. At least one telemetry tagged Gulf sturgeon was located (prior to this study) near shipping lanes in the Mississippi River Gulf Outlet (MRGO) – maintained by the U.S. Army Corps of Engineers (H. Rogillio, personal communication). Pearl River Gulf sturgeon would likely be the only population affected by such maintenance activities since no tagged Gulf sturgeon from the nearby river systems, such as the Pascagoula River, have been located.

Despite over a decade of study, much remains to be learned about limiting factors influencing population growth of Gulf sturgeon (U.S. Fish and Wildlife Service (USFWS) and GSMFC 1995; Morrow et al. 1999). A lawsuit has required the USFWS to propose critical habitats. This ruling could potentially affect Corps of Engineers responsibilities aimed at maintaining established shipping lanes in – but not necessarily limited to – the MRGO. The MRGO has been dredged, and dredged material has been disposed of at near-shore sites. Gulf sturgeon are feared susceptible to these maintenance operations. Dredging and other channel maintenance activities

can also obstruct or alter migratory pathways, a primary concern of the USFWS in their designation of critical habitat.

Beginning in 2004, a 3-year study began to evaluate the potential occurrence of Gulf sturgeon in the MRGO. The presence of this listed species in the MRGO would require careful consideration of potential impacts of dredging and disposal operations. Gulf sturgeon use of the MRGO was intensively evaluated by telemetry and netting. To address stated concerns by the USFWS, MRGO inland disposal occupied by juveniles was sampled. In addition, population models were used to evaluate potential impacts of incidental kill caused by channel maintenance activities on long-term recruitment as part of a risk assessment.



## 2 Methods

Gulf sturgeon were netted yearly (June through September) in the Pearl River system by biologists from the U.S. Army Engineer Research and Development Center (ERDC) and the Louisiana Department of Wildlife and Fisheries (LDWF). Fish were weighed, measured, tagged for later identification, and some fish were instrumented with radio, sonic, or dual tags for telemetry studies. This sampling (as well as sampling by the LDWF prior to 2004) provided input for estimating population attributes as well as tagged fish for monitoring movement in the MRGO.

This study approach has been used in previous Pearl River studies (Morrow et al. 1998b, 1999) to evaluate population trends, define minimum levels of total mortality leading to population growth, evaluate the impacts of commercial by catch on population growth, and to develop recovery benchmarks (Powers 1996) such as acceptable population size or total annual mortality. Age, growth, and recapture information was then used in age-structure models using MOCPOP 2.0 (Beamesderfer 1991) to ascertain population trends in the Pearl River system and simulate the potential impacts of dredging and disposal operations. Rates of recruitment based upon earlier work in the 1990s (Morrow et al. 1998b) and mortality estimates generated in this and earlier studies were used to parameterize these models (Table 1). The population size was estimated with yearly recapture information using NOREMARK (White 1996), a program that estimates abundance using capture-recapture methods and a joint hypergeometric maximum likelihood estimator. Total annual mortality was estimated using the Gulland modification (Gulland 1983) as follows:

$$Z = k (L_{\infty} - L_{mean}) / (L_{mean} - L_c)$$

Table 1 explains the parameters.

Gulf sturgeon tagged with sonic transmitters were available for telemetry tracking in the MRGO beginning in the Fall of 2004. At least monthly, the MRGO was monitored using a Sonotronics receiver and hydrophone. Biologists would stop every 0.7 km and listen for sonically tagged sturgeon from the mouth of the MRGO to about marker 60. Water quality was

measured with a Hydrolab® and included temperature, conductivity, dissolved oxygen, and salinity.

**Table 1. Parameters used in population models and to estimate population attributes.**

Parameter	Definition
$Z$	The instantaneous rate of total mortality
$k$	Growth constant from the von Bertalanffy growth equation
$L_{\infty}$	Theoretical maximum fork length from the von Bertalanffy growth equation
$L_{mean}$	Mean fork length at capture
$L_c$	Minimum fork length captured
Model run time	30 years
Lifespan	Set at 25 years
Recruitment	Set constant at age 1 or related to stock size
Survival	A combination of values set for natural and fishing mortality

The USFWS raised concerns that juvenile or nonspawning adult Gulf sturgeon may reside, during warmer months, in MRGO disposal areas rather than the lower reaches of the Pearl River. This supposition is supported by earlier cooperative studies (Rogillio et al. 2007) in which juveniles were captured not far (<20 km) from the MRGO in the lower Pearl River system. Telemetry and limited netting were conducted monthly to determine presence of Gulf sturgeon in and nearby these disposal areas. During the summer and fall of 2006, fleets of gill nets (ten 2-m depth, experimental, monofilament nets measuring 100 m) were set by ERDC and LDWF biologists in and near disposal sites to intensively sample for Gulf sturgeon.

### 3 Results and Discussion

The Appendix, provided by the LDWF, lists approximately 180 tagged Gulf sturgeon beginning in 2000. It was judged, based upon guaranteed battery life and tag retention, that conservatively 50, 40, and 20 Gulf sturgeon would be available for tracking during 2004, 2005, and 2006, respectively. The number of tagged fish represented a substantial portion of the Pearl River population that was estimated to range between 200 through 536 during the period 2000 through 2004 (Table 2).

Table 2. Estimates of the instantaneous rate of total mortality ( $Z$ ), estimated population size, and 95% confidence interval for the Gulf sturgeon population in the Pearl River system during 2000 through 2006.

Year	$Z$	Estimate Population Size	95% Confidence Interval
2000	0.15	222	134 to 379
2001	0.07	536	323 to 1,031
2002	0.05	246	199 to 317
2003	0.04	200	54 to 345
2004	0.05	277	210 to 434
2005	No estimate since only 18 fish were caught.		
2006	0.38		
2007	0.05		

The use of estimated population size as a recovery benchmark was suspended in 2005 because overlapping confidence intervals would not allow population trends to be detected (Table 2). However, acceptable rates of total annual mortality measured as  $Z$ , the instantaneous rate of total mortality (Ricker 1975), were developed by population models and selected as an alternative benchmark. These mortality estimates, also listed in Table 2, were arrived at using summer netting in the Pearl River system. Mortality appeared to be within a satisfactory range (i.e.,  $Z = 0.16$  to  $0.24$ ) across a range of years except for 2006 when an estimate of  $Z$  was 0.38; this level of mortality is outside the range that modeling in this study and earlier studies (Morrow et al. 1998b) suggests is sustainable. Gulf sturgeon were apparently displaced after Hurricane Katrina resulting in spurious

estimates of mortality. However, mortality estimates derived during 2007 ( $Z = 0.05$ ) suggest minimal mortality was caused by the hurricane.

After joint tagging efforts beginning in the summer of 2004, the inland portion of the MRGO was surveyed using mobile sonic monitoring. Approximately 100 soundings were made monthly in the MRGO and a total approaching 2,400 soundings were made during the period of this study. Only one Gulf sturgeon was located in the MRGO on 19 January 2005 near marker 96 (29° 50.669N 089° 37.643W). This juvenile fish was captured and tagged on 19 August 2004 in the East Pearl River near the National Aeronautics and Space Administration's (NASA's) John C. Stennis Space Center.

Disposal areas were routinely surveyed using mobile telemetry and periodically sampled with gill nets for Gulf sturgeon during 2004 and 2005. In order to address concerns of the USFWS concerning summering populations of juveniles in or near the disposal areas, intensive gill netting by LDWF and ERDC was conducted from May through September of 2006. A total of 10,633 net-meter-hours of netting was expended and no Gulf sturgeon were captured. Therefore, it was impractical to make generalizations about habitat utilization.

## **4 Implication for Corps of Engineers Channel Maintenance**

In summary, this was an intensive study of the potential impacts of channel maintenance in the MRGO on the Pearl River population of Gulf sturgeon. A very substantial portion of the population (perhaps as much as 25 percent) was telemetry tagged and subject to detection in the MRGO during monthly telemetry surveys. Since only one juvenile Gulf sturgeon was detected, use of the MRGO by Gulf sturgeon of any size or at any time of the year appears to be a rare event.

Summertime use of inland disposal sites was not detected despite the location of juvenile populations in the nearby lower Pearl River. As a consequence of intensive gill netting and telemetry, it is concluded that summer use in and near disposal areas is unlikely. However, it cannot be unequivocally stated that this species does not occasionally move into the MRGO. Maintenance activities that impact these fish should be monitored.

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## Appendix A: Summary of Gulf Sturgeon Tagged in Pearl River System, 2000–2006

This appendix includes a summary, provided by the Louisiana Department of Wildlife and Fisheries, of Gulf sturgeon tagged with sonic transmitters in the Pearl River system, Louisiana from 2000 to 2006. Information includes date, river location of capture, total length (TL) in inches, fork length (FL) in inches, weight (WT) in pounds, floy tag number, pit tag number (PIT #), and sonic beep sequence.

Date	Location	TL	FL	WT, lb	WT, g	Tag#	PIT#	Sequence
08/02/00	Bogue Chitto River -Paige Lake	55.0	48.5	44.00		25	026.787.844	2.7.5
08/02/00	Bogue Chitto River -Paige Lake	77.0	69.0	120.00		164	005.552.311	6.6.9
09/26/00	Bogue Chitto River -Paige Lake	72.0	67.0	100.00			001.825.617	2.3.3.6
09/26/00	Bogue Chitto River -Paige Lake	77.0	70.0	122.00		164	005.552.311	2.3.5.4
09/26/00	Bogue Chitto River -Paige Lake	65.5	60.5	71.00		263	019.778.292	2.3.6.3
09/26/00	Bogue Chitto River -Paige Lake	62.0	56.5	64.00			015.090.615	2.4.4.4
09/26/00	Bogue Chitto River -Paige Lake	78.0	70.5	108.00			012.315.543	9.7.9.7
10/31/00	Bogue Chitto River -Paige Lake	65.0	60.0	73.00		153	020.082.538	2.4.9
10/31/00	Bogue Chitto River -Paige Lake	63.0	58.0	60.00		161	009.822.867	2.5.8
10/31/00	Bogue Chitto River -Paige Lake	78.0	72.0	143.00		168	001.320.808	2.6.7
10/31/00	Bogue Chitto River -Paige Lake	66.5	60.0	65.00		166	012.040.099	2.8.4
10/31/00	Bogue Chitto River -Paige Lake	61.0	57.0	66.00		208	006.596.047	2.9.3
10/31/00	Bogue Chitto River -Paige Lake	74.5	70.0	117.00		215	005.552.311	3.3.9
10/31/00	Bogue Chitto River -Paige Lake	56.5	52.0	45.00		71	013.851.521	3.4.12
10/31/00	Bogue Chitto River -Paige Lake	77.5	72.0	122.00		209	021.046.820	3.4.8
10/31/00	Bogue Chitto River -Paige Lake	60.0	54.0	57.00		51	013.543.087	3.5.7
10/31/00	Bogue Chitto River -Paige Lake	66.0	60.5	83.00		157	007.521.071	3.6.6
10/31/00	Bogue Chitto River -Paige Lake	60.0	54.0	42.00		26	026.555.329	4.4.11
10/31/00	Bogue Chitto River -Paige Lake	60.5	54.0	51.00		169	018.084.109	4.5.10
10/31/00	Bogue Chitto River -Paige Lake	61.0	55.0	46.00		211	015.105.107	4.5.6
10/31/00	Bogue Chitto River -Paige Lake	52.0	47.0	36.00		174	020.519.070	5.5.9
10/31/00	Bogue Chitto River -Paige Lake	56.0	50.5	39.00		155	019.076.564	5.6.8
05/02/01	Tickfaw River	46.0	41.0	20.00		719	019.013.288	2.4.2.6



Date	Location	TL	FL	WT, lb	WT, g	Tag#	PIT#	Sequence
06/06/01	Pascagoula Riv. @ Papermill Camp	53.5	50.0	41.00			026.551.622	2.2.4.5
07/03/01	Bogue Chitto River -Paige Lake	62.0	58.0	74.00		263	019.778.292	2.2.3.7
07/10/01	Bogue Chitto River -Paige Lake	67.0	64.0	97.00		167	005.312.520	2.2.2.8
07/10/01	Bogue Chitto River -Paige Lake	61.0	56.0	65.00		206	017.311.112	2.2.5.5
07/24/01	Bogue Chitto River -Page Lake	81.0	75.5	134.00		126	045.522.120	2.2.4.6
08/07/01	Bogue Chitto River -Page Lake	76.0	69.0	131.00		133	045.342.280	3.6.7
08/07/01	Bogue Chitto River -Page Lake	71.5	66.5	98.00		146	045.368.263	4.4.4
08/07/01	Bogue Chitto River -Page Lake	66.0	61.0	80.00		183	045.583.121	5.5.3
08/07/01	Bogue Chitto River -Page Lake	63.0	58.0	53.00		140	045.338.040	5.5.5
08/07/01	Bogue Chitto River -Page Lake	67.0	62.0	69.00		147	045.376.013	5.6.7
08/22/01	Bogue Chitto River -Paige Lake	64.0	58.0	61.00		105	045.383.358	5.5.5.d
08/23/01	Bogue Chitto River -Paige Lake	65.0	57.0	70.00		103	045.374.007	4.4.5
08/23/01	Bogue Chitto River -Paige Lake	61.5	55.0	58.00		111	045.613.314	5.3.6
08/28/01	Bogue Chitto River -Paige Lake	66.5	62.0	78.00		119	045.547.366	4.7.8
08/29/01	Bogue Chitto River -Paige Lake	79.0	69.0	110.00		108	017.092.094	3.3.4
09/25/01	Bogue Chitto River -Paige Lake	71.5	67.0	103.00		121	052.267.319	4.4.8
05/23/02	Bogue Chitto River -Paige Lake	73.0	68.5	100.00		287	020.082.538	6.7.9
05/23/02	Bogue Chitto River -Paige Lake	85.9	81.5	227.00		299	049.810.050	6.9.9
05/23/02	Bogue Chitto River -Paige Lake	86.5	78.0	177.00		288	049.793.866	8.9.9
06/04/02	Bogue Chitto River -Paige Lake	81.0	76.5	193.00		286	049.803.801	7.7.9
06/04/02	Bogue Chitto River -Paige Lake	68.0	62.0	88.00		236	049.772.516	7.9.9
06/11/02	Bogue Chitto River -Paige Lake	54.5	49.5	41.00			017.122.016	2.5.2.5
06/11/02	Bogue Chitto River -Paige Lake	89.5	84.0	325.00		237	049.118.091	3.7.8
06/11/02	Bogue Chitto River -Paige Lake	67.5	64.5	90.00		248	049.769.529	4.3.4
06/13/02	Bogue Chitto River -Paige Lake	69	64.0	104.00		229	007.571.071	7.7.7
06/19/02	Bogue Chitto River -Dobsom's	69.0	63.5	98.00		249	048.019.309	6.6.7
06/19/02	Bogue Chitto River -Dobsom's	67.0	62.0	82.00		203	045.516.308	6.8.8d
06/19/02	Bogue Chitto River -Dobsom's	69.0	61.0	82.00		101	036.285.074	6.8.9
06/20/02	Bogue Chitto River -Dobsom's	58	53	50.00		216	016.023.517	2.3.4.5
06/25/02	Bogue Chitto River -Dobsom's	81	75	150.00		275	048.262.306	4.7.8
06/25/02	Bogue Chitto River -Dobsom's	67.0	62.0	90.00		119	045.547.366	7.8.8
06/25/02	Bogue Chitto River -Dobsom's	68.0	63.0	93.00		297	049.300.529	8.8.9
06/27/02	Bogue Chitto River -Dobsom's	76.0	69.5	126.00		251	045.342.280	4.7.7
06/27/02	Bogue Chitto River -Dobsom's	62.0	57.0	64.00		256	045.383.358	5.5.5

Date	Location	TL	FL	WT, lb	WT, g	Tag#	PIT#	Sequence
07/02/02	Bogue Chitto River -Dobsom's	67.0	63.0	90.00		167	005.312.520	2.3.9
07/17/02	Bogue Chitto River -Dobsom's	89.0	82.0	200.00		261	048.014.822	2.5.6
07/17/02	Bogue Chitto River -Dobsom's	77.5	69.5	114.00		115	045.530.096	8.8.8
08/27/02	Bogue Chitto River -Dobsom's	61.0	56.0	60.00		141	045.372.063	6.6.8
08/27/02	Bogue Chitto River -Dobsom's	78	71	126.00		124	052.274.045	6.8.8d
09/10/02	Bogue Chitto River -Pages	67.0	63.0	90.00		167	005.312.520	2.3.9
09/11/02	Bogue Chitto River -Pages	85	79	171.00		192	045.614.884	5.5.6
09/16/02	Bogue Chitto River - Pages	74	70	168.00		262	048.283.825	2.3.4
09/16/02	Bogue Chitto River -Pages	75	69	121.00		274	048.104.379	6.7.7
05/14/03	Bogue Chitto River - Pages	75	68.5	130.00		918	048.014.359	6.7.8
05/21/03	Bogue Chitto River - Pages	74	66	106.00		249	048.019.309	3.4.7.7
05/29/03	Bogue Chitto River -Dobsom's	78.5	71.5	140.00		952	048.011.099	3.4.4.6
05/29/03	Bogue Chitto River -Dobsom's	79	71	135.00		251	045.342.280	3.4.6.7
06/02/03	Bogue Chitto River - Pages	70.5	65	106.00		957	048.113.587	3.4.5.5.
06/02/03	Bogue Chitto River - Pages	69.25	64.25	111.00		167	005.312.520	3.4.5.6
06/02/03	Bogue Chitto River - Pages	73.5	65	106.00		166	012.040.099	3.4.7.6
06/03/03	Bogue Chitto River - Pages	66	60.5	71.00		211	015.105.107	3.4.6.4
06/10/03	Bogue Chitto River - Pages	78	75	156.00		969	048.030.005	3.4.4.7
07/22/03	Bogue Chitto River -Dobsom's	77.5	70	126.00		251	045.342.280	3.5.4.5
08/12/03	Bogue Chitto River - Pages	78	70	126.00		906	005.552.311	3.4.6.6
08/12/03	Bogue Chitto River -Dobsom's	70	65	101.00		967	048.049.307	3.5.6.4
08/13/03	Bogue Chitto River - Pages	85	76.5	180.00		265	048.011.884	3.5.7.4
08/19/03	Bogue Chitto River - Pages	72	65	100.00		963	052.267.319	3.4.7.5
08/20/03	Bogue Chitto River - Pages	73.5	65.5	111.00		966	058.872.107	3.5.4.4
09/16/03	Bogue Chitto River -Dobsom's	73.5	65.5	108.00		966	058.872.107	3.4.6.5
09/16/03	Bogue Chitto River -Dobsom's	87.5	82	221.00		299	059.024.818	7.7.8
09/19/03	Bogue Chitto River - Pages	80	72.5	122.00		912	045.522.120	3.4.4.5
09/19/03	Bogue Chitto River - Pages	59	54	51.00		915	058.776.066	3.4.5.4
09/19/03	Bogue Chitto River - Pages	66	60	76.00			019.778.292	3.4.7.4
09/24/03	Bogue Chitto River - Pages	77.5	70	121.00		251	045.342.280	3.6.3.6
09/24/03	Bogue Chitto River -Dobsom's	61	54	54.00		951	026.865.830	3.6.4.5
10/02/03	Bogue Chitto River - Pages	70.5	63.5	100.00		264	048.016.627	3.5.6.5
10/02/03	Bogue Chitto River - Pages	60	54.5	59.00		257	026.818.123	3.6.4.4
10/06/03	Bogue Chitto River -Dobsom's	60	56	61.00		994	059.026.126.	3.5.6.6

Date	Location	TL	FL	WT, lb	WT, g	Tag#	PIT#	Sequence
10/06/03	Bogue Chitto River - Pages	60	54	50.00		279	058.872.318	3.5.6.7
10/06/03	Bogue Chitto River -Dobsom's	78	75	146.00		969	048.030.005	3.5.7.6
10/06/03	Bogue Chitto River - Pages	79	72	131.00		930	058.634.825	3.5.7.7
10/07/03	Bogue Chitto River -Dobsom's	69.0	63.0	93.00		989	048.057.515	3.5.5.7
06/24/04	Bogue Chitto River - Pages	75	68	111.00		913	048.262.306	3.4.8.9
06/24/04	Friday's ditch Upper Pearl River	34.75	31.25	7.00		946	058.639.053	4.4.5.6
07/20/04	Bogue Chitto River - Pages	66.75	61	86.00		396	049.782.619	3.6.4.6
07/20/04	Bogue Chitto River - Below Pages	72	67	114.00		229	007.571.071	3.7.5
07/20/04	Bogue Chitto River - Pages	74	65	106.00		957	048.113.587	5.6.7
07/21/04	Bogue Chitto River - Below Pages	63	58	68.00		979	058.327.288	3.5.3.5
07/22/04	East Pearl @ NASA	32.5	29	5.44	2471	371	058.334.534	
08/10/04	East Pearl @ NASA	22.75	20.5	1.83	832	340	058.336.805	
08/11/04	East Pearl @ NASA	36	32	7.30		927	058.853.111	
08/11/04	East Pearl @ NASA	18.5	16.5	0.88	398	31988	058.862.302	
08/11/04	East Pearl @ NASA	49	43.5	23.80		950	059.045.302	3.5.5.5
08/11/04	Bogue Chitto River - Pages	60.25	53	54.60		374	017.109.078	3.5.5.6
08/11/04	East Pearl @ NASA	26.5	23.5	2.74	1244	938	059.026.578	3.6.3.7
08/11/04	East Pearl @ NASA	45	39.5	15.20		949	058.866.846	4.4.4.4
08/11/04	Bogue Chitto River - Pages	47.5	42.75	22.00		357	011.772.085	4.4.4.5
08/11/04	Bogue Chitto River - Pages	72	67	114.00		229	007.571.071	4.4.7
08/11/04	East Pearl @ NASA	32.75	28.75	5.49	2494	931	058.341.849	
08/11/04	East Pearl @ NASA	18.75	16.75	0.90	408	31989	058.342.893	
08/11/04	East Pearl @ NASA	34.5	31	6.00		935	058.864.576	
08/12/04	Bogue Chitto River - Pages	49.5	43.25	20.40		359	022.323.606	4.4.6.5
08/12/04	East Pearl @ NASA	21	18	1.12	507	373	022.058.359	
08/12/04	East Pearl @ NASA	18	15.5	0.75	342	375	022.374.293	
08/17/04	Bogue Chitto River - Pages	43.5	39	16.10		358	022.588.322	4.4.4.8
08/17/04	Bogue Chitto River - Pages	45.5	40.5	15.70		370	021.855.637	4.4.5.7
08/17/04	East Pearl @ NASA	25.5	22.5	2.30	1042	360	022.826.578	
08/17/04	East Pearl @ NASA	32.5	29	5.44	2471	371	058.334.534	
08/17/04	Bogue Chitto River -Dobsom's	65	59.5	72.00		920	019.778.292	
08/18/04	Bogue Chitto River - Pages	66.5	60	77.20		362	048.078.025	3.5.8.4
08/19/04	East Pearl @ NASA upper	35.5	31.25	6.73	3056	940	055.839.260	4.4.5.8
08/19/04	East Pearl @ NASA launch	32.5	29	5.44	2471	371	058.334.534	

Date	Location	TL	FL	WT, lb	WT, g	Tag#	PIT#	Sequence
08/19/04	East Pearl @ NASA upper	26	23.5	2.60	1179	945	059.031.840	
08/19/04	Friday's ditch Pearl River	15.5	13.5	0.53	242	31991		
08/19/04	East Pearl @ NASA upper	17.5	15.5	0.75	341	31990		
09/01/04	Bogue Chitto River - Pages	38	34.25	10.10		311	014.279.806	3.3.5
09/01/04	Bogue Chitto River - Pages	51	46.5	29.00		927	022.585.110	3.5.3.6
09/01/04	Bogue Chitto River - Pages	53	47	32.60		363	023.055.832	3.5.4.6
09/01/04	East Pearl NASA	31.0	27.5	4.74	2150	376	051.622.886	
09/08/04	Bogue Chitto River -Dobsom's	58	52	43.60		368	072.039.379	3.5.5.8
09/09/04	Bogue Chitto River -Dobsom's	68.5	61	71.30		903	026.551.622	3.5.5.9
09/09/04	Bogue Chitto River -Dobsom's	63	58	59.50		301	013.373.082	3.5.7.9
09/09/04	Bogue Chitto River -Dobsom's	62	58	61.30		910	026.555.329	3.5.8.7
09/09/04	East Pearl NASA upper	17.5	15.25	0.57	258	31999		
09/09/04	East Pearl NASA	17.5	15.25	0.65	294	31997		
09/29/04	Bogue Chitto River -Dobsom's	83	75	158.50		369	052.274.045	3.5.7.5
09/29/04	Bogue Chitto River -Dobsom's	64	59	62.75		316	071.831.862	3.5.8.5
10/12/04	Bogue Chitto River - water fall	67.5	63.0	80.50		384	002.344.606	3.5.8.6
10/12/04	Bogue Chitto River - Pages	58.5	53	48.70		364	071.634.335	
10/12/04	Bogue Chitto River - Pages	53.8	48.25	32.70		351	072.079.772	
10/13/04	Bogue Chitto River - Pages	58.5	53	48.70		364	071.634.335	3.5.6.9
10/13/04	Bogue Chitto River - Pages	63	58	61.00		391	049.854.779	3.5.7.8
10/25/04	Bogue Chitto River - Pages	60.5	55.5	42.00		398	072.117.831	3.5.6.8
10/25/04	Bogue Chitto River - water fall	48	44.0	23.00		390	072.015.513	4.4.5.5
10/25/04	E. Pearl River NASA	32	28	4.93	2239	379	048.123.824	
10/25/04	Bogue Chitto River - Pages	62	57	68.00		399	026.777.339	
10/26/04	Pearl River - Mud/little Lake	38	34	10.60		371	071.610.871	
04/12/05	Bogue Chitto River -Dobsom's	48	43	28.60		395	072.066.556	3.5.3.9
04/12/05	Bogue Chitto River - Pages	55	49	44.50		400	071.778.596	
04/13/05	E. Pearl River NASA	32	29	5.55	2519	389	071.545.325	
06/07/05	E. Pearl River NASA	25.75	23.25	2.69	1221	385	071.625.351	
06/08/05	Bogue Chitto River - water fall	56.25	51.75	48.00		995	058.629.098	3.4.9.8
06/09/05	Bogue Chitto River - Pages	53	48.25	35.00		392	071.840.610	3.4.6.9
06/09/05	Bogue Chitto River -Dobsom's	47.5	42.5	21.90		366	043.616.357	4.4.5
06/21/05	Bogue Chitto River -Dobsom's	66.5	61	74.40		372	049.808.354	3.3.7
06/21/05	Bogue Chitto River -Dobsom's	65	58	55.70		393	045.588.794	3.4.8.6

Date	Location	TL	FL	WT, lb	WT, g	Tag#	PIT#	Sequence
07/14/05	Bogue Chitto River - Pages	57.5	51.75	41.00		377	071.548.549	3.3.3
07/14/05	Bogue Chitto River -Dobsom's	50	46.5	26.80		390	072.015.513	3.4.5
07/14/05	Bogue Chitto River -Dobsom's	57	53	52.30		352	071.861.026	3.4.9.9
07/14/05	Bogue Chitto River - water fall	52	46.5	30.30		397	071.631.829	4.3.5
07/14/05	Bogue Chitto River - water fall	48	42.5	23.90		388	071.871.518	4.4.4
08/17/05	friday'sditch upper Pearl River	32.25	28.25	5.70		312	071.891.111	
02/14/06	friday'sditch upper Pearl River	34	30	6.35	2881	939	071.637.376	
05/17/06	friday'sditch upper Pearl River	24	22	2.64	1198	934	071.865.535	
06/12/06	Bogue Chitto River - Pages	65	59	74.00		329	019.778.292	4.4.7.7
06/12/06	Bogue Chitto River - Pages	55.5	49.25	46.00		346	072.087.567	4.4.8.8
06/12/06	friday'sditch upper Pearl River	43.25	38.75	18.00		344	072.043.089	6.6.6.
06/12/06	Friday'sditch Pearl River	32.25	28.25	5.70		312	071.897.111	
06/12/06	friday'sditch upper Pearl River	29.5	25.5	4.14	1878	948	072.019.047	
06/12/06	friday'sditch upper Pearl River	17.5	16	0.84	380	31676		
06/12/06	friday'sditch upper Pearl River	19.25	17.25	1.13	512	31677		
06/12/06	friday'sditch upper Pearl River	19.25	17.25	1.08	490	31678		
06/14/06	friday'sditch upper Pearl River	38	34	9.31	4225	928	059.042.298	3.2.7
06/19/06	friday'sditch upper Pearl River	31	28.5	6.63	3009	302	071.820.794	
06/19/06	friday'sditch upper Pearl River	19.25	16.75	1.01	457	30930		
06/19/06	friday'sditch upper Pearl River	18.5	16.25	0.95	431	31949		
07/12/06	friday'sditch upper Pearl River	47	41	20.00		313	071.540.339	4.4.8
07/12/06	friday'sditch upper Pearl River	80	75	155.00		314	049.769.529	

<h1 style="text-align: center;">REPORT DOCUMENTATION PAGE</h1>				<p style="text-align: right;"><i>Form Approved</i> <i>OMB No. 0704-0188</i></p>	
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<b>1. REPORT DATE (DD-MM-YYYY)</b> June 2008		<b>2. REPORT TYPE</b> Final report		<b>3. DATES COVERED (From - To)</b>	
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				<b>5b. GRANT NUMBER</b>	
				<b>5c. PROGRAM ELEMENT NUMBER</b>	
<b>6. AUTHOR(S)</b>  James P. Kirk				<b>5d. PROJECT NUMBER</b>	
				<b>5e. TASK NUMBER</b>	
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<b>12. DISTRIBUTION / AVAILABILITY STATEMENT</b>  Approved for public release; distribution is unlimited.					
<b>13. SUPPLEMENTARY NOTES</b>					
<b>14. ABSTRACT</b>  <p>The Mississippi River Gulf Outlet (MRGO) provides year-round navigation between the Mississippi River and the Gulf of Mexico. Dredging, which is periodically required to maintain navigation, may impact Gulf sturgeon. Consequently, Gulf sturgeon use of the MRGO and nearby disposal areas was monitored monthly from 2004 through 2006 using telemetry tracking. A total of 50, 40, and 20 Gulf sturgeon were captured yearly by netting in the Pearl and Bogue Chitto Rivers and fitted with transmitters. One tagged Gulf sturgeon was located in the MRGO on 19 January 2005 near marker 96 (29° 50.669N 089° 37.643W). Starting in June 2006, intensive gill netting of disposal sites was initiated as telemetry monitoring continued. No other Gulf sturgeon were located by telemetry nor were any caught in experimental gill nets near inland disposal sites despite more than 10,600 net meter hours of effort expended in 2006. This study thus suggests that Gulf sturgeon infrequently use the MRGO and nearby disposal areas.</p>					
<b>15. SUBJECT TERMS</b> <div style="display: flex; justify-content: space-between;"> <span>Gulf sturgeon</span> <span>Monitoring</span> <span>Navigation</span> </div>					
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